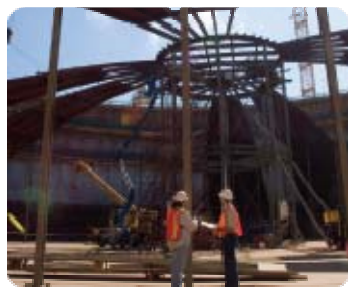


BUILDING A WORLD OF DIFFERENCE®



## **Analysis of California Natural Gas Market, Supply Infrastructure, Regulatory Implications, and Future Market Conditions**

**CIEE Subcontract No. MNG-07-01**

**Natural Gas Storage Forum:  
Modeling of Natural Gas Market in California**

**November 15, 2007**

# Modeling of Natural Gas Market in California

- Overview of NARG Model
- Analysis for Demand Projections
- Key Results from Fundamental Analysis of California Market
- Summary Observations

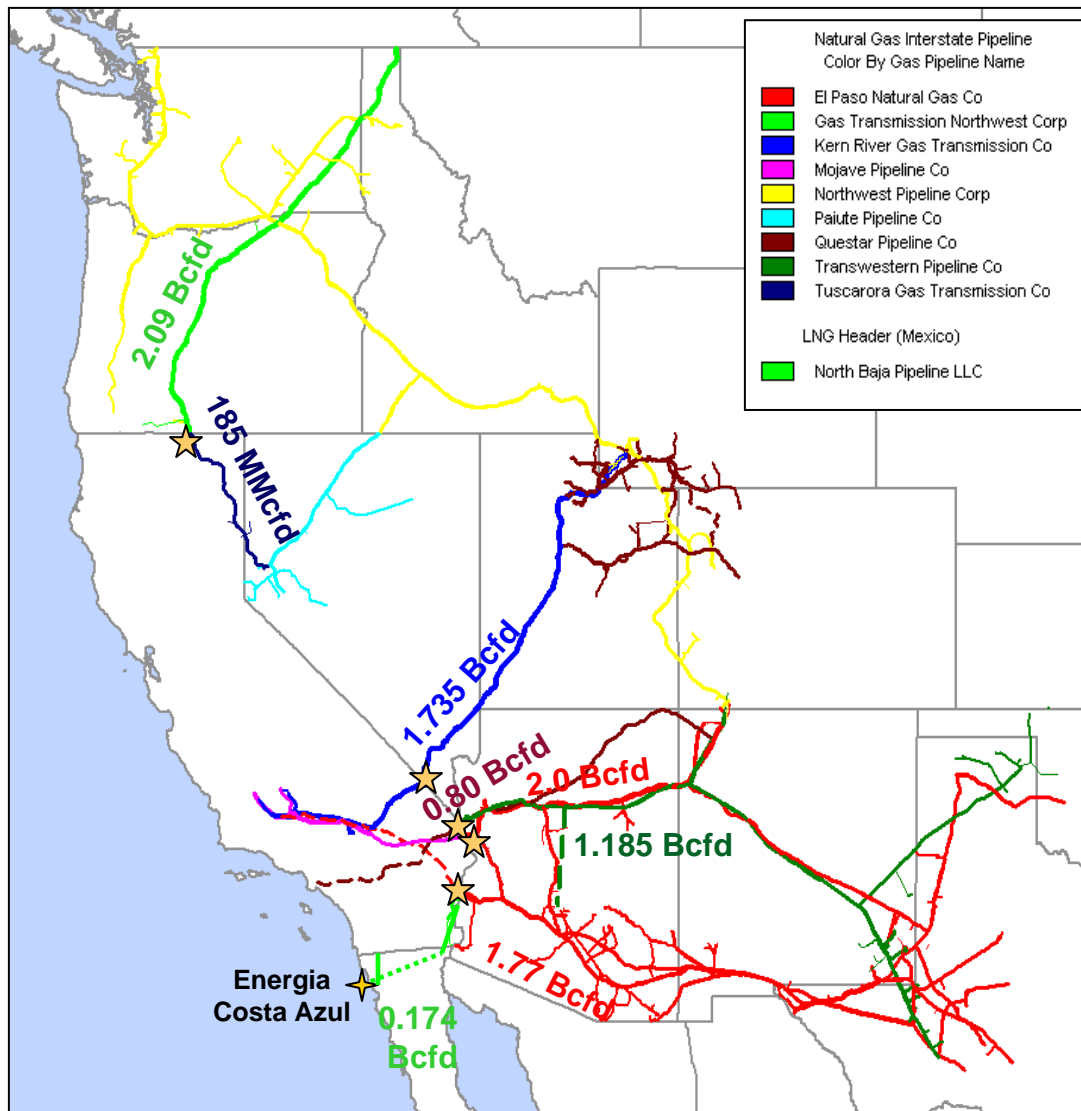
## North America Regional Gas model (NARG)

- NARG is a fundamental model that estimates the equilibrium price, consumption and production in each defined North America market by balancing natural gas demand and supply
  - Simulates market behavior by creating a network representation of each economically distinct element of the natural gas industry
  - Models are comprehensive and include gas reserves, processing plants, storage facilities, transportation pipelines and final market demand by sector
  - Microeconomic theory is used to simulate the real world interaction of these elements to determine future prices, production levels, demand loads, pipeline flows, storage withdrawals/injections

## North America Regional Gas model (NARG)

- B&V has extensive experience using NARG for fundamental analysis of the North American market
  - Numerous engagements over 5 years analyzing supply, demand, infrastructure and price trends
  - Detailed representation of the North American natural gas grid with inputs that have been validated through various engagements
- Natural gas infrastructure in North America, with specific focus on California, has been modeled as part of the research study
- For the purpose of this study, the model analyzed a time period from 2008 to 2020 with monthly resolution

# Interstate Pipeline Capacity Across CA border



Pipeline	Location	Delivery Capacity
Gas Transmission Northwest	Malin	2.09 Bcf/d
El Paso Natural Gas	Topock	2.00 Bcf/d
El Paso Natural Gas	Blythe	1.77 Bcf/d
Transwestern	N. Needles & Topock	1.185 Bcf/d
Kern River Transmission	Goodsprings Compressor	1.735 Bcf/d
TGN (LNG)	Mexico Border	174 MMcf/d
Tuscarora*	Malin	185 MMcf/d
Questar – Southern Trails	N. Needles	80 MMcf/d

\* Natural gas flows through the state of California on the Tuscarora pipeline

Source: Energy Velocity; Final Reference Case in Support of the 2005 Natural Gas Assessment – CEC, Nov 2005

## Storage Facilities in California – Existing & Proposed

Storage Field	Ownership	Working Gas Capacity (Bcf)	Max Deliverability (MMcf/d)	Turns of Service	Pipeline Interconnects	Status
Lodi Gas Storage	Lodi Gas Storage LLC.	12.0	450	7	PG&E	Operating
Kirby Hills Storage	Lodi Gas Storage Co.	5.5	100	3	PG&E	Operating
Wild Goose Storage	Niska Gas Storage - Carlyle/Riverstone	24.0	480	4	PG&E	Operating
Honor Rancho Storage Field	SoCal	20.0	1,000	4	SoCal	Operating
La Goleta	SoCal	20.5	420	2	SoCal	Operating
Playa del Rey	SoCal	2.6	480	9	SoCal	Operating
Aliso Canyon	SoCal	77.0	1,860	1	SoCal	Operating
Los Medanos	PG&E	17.5	350	1	PG&E	Operating
McDonald Island	PG&E	82.0	1,300	1	PG&E	Operating
Pleasant Creek	PG&E	2.3	70	1	PG&E	Operating
Sacramento Natural Gas Facility	Sacramento Natural Gas Storage Co.	7.5	200	3	Sacramento Municipal Utility District, PG&E	Proposed - Expected In Service 2008
Kirby Hills Area Expansion	Lodi Gas Storage Co.	12.0	200	2	PG&E	Proposed - Expected In Service 2008
Wild Goose Expansion	Niska Gas Storage - Carlyle/Riverstone	5.0	TBD	TBD	PG&E	Proposed
Gill Ranch Storage <sup>10</sup>	Gill Ranch Storage, LLC	15.0	485	3	PG&E	Proposed - Expected In Service 2010

# Modeling of Natural Gas Market in California

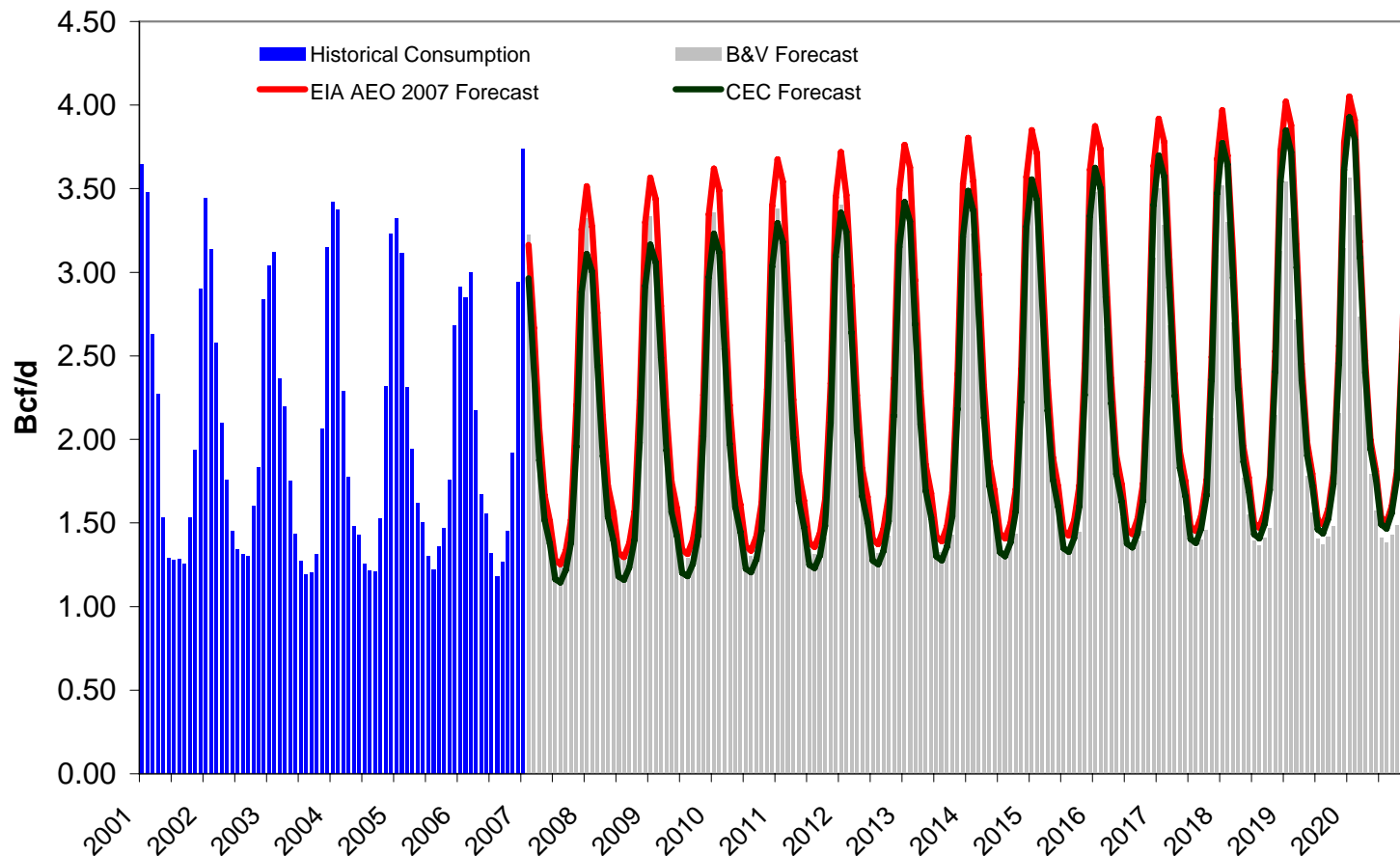
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## Analysis for Demand Projections

- Regression based analysis for residential, commercial and industrial demand
  - Explanatory variables – weather, prices, lag of demand, macroeconomic variables
- Dispatch based electricity demand
  - Fundamental electricity dispatch model with 14 power service territories in California
  - Integrated with NARG model
- Peak day demand based on historic data

## Residential and commercial demand is forecast to grow by 0.7% CAGR or 55 Bcf during the study period

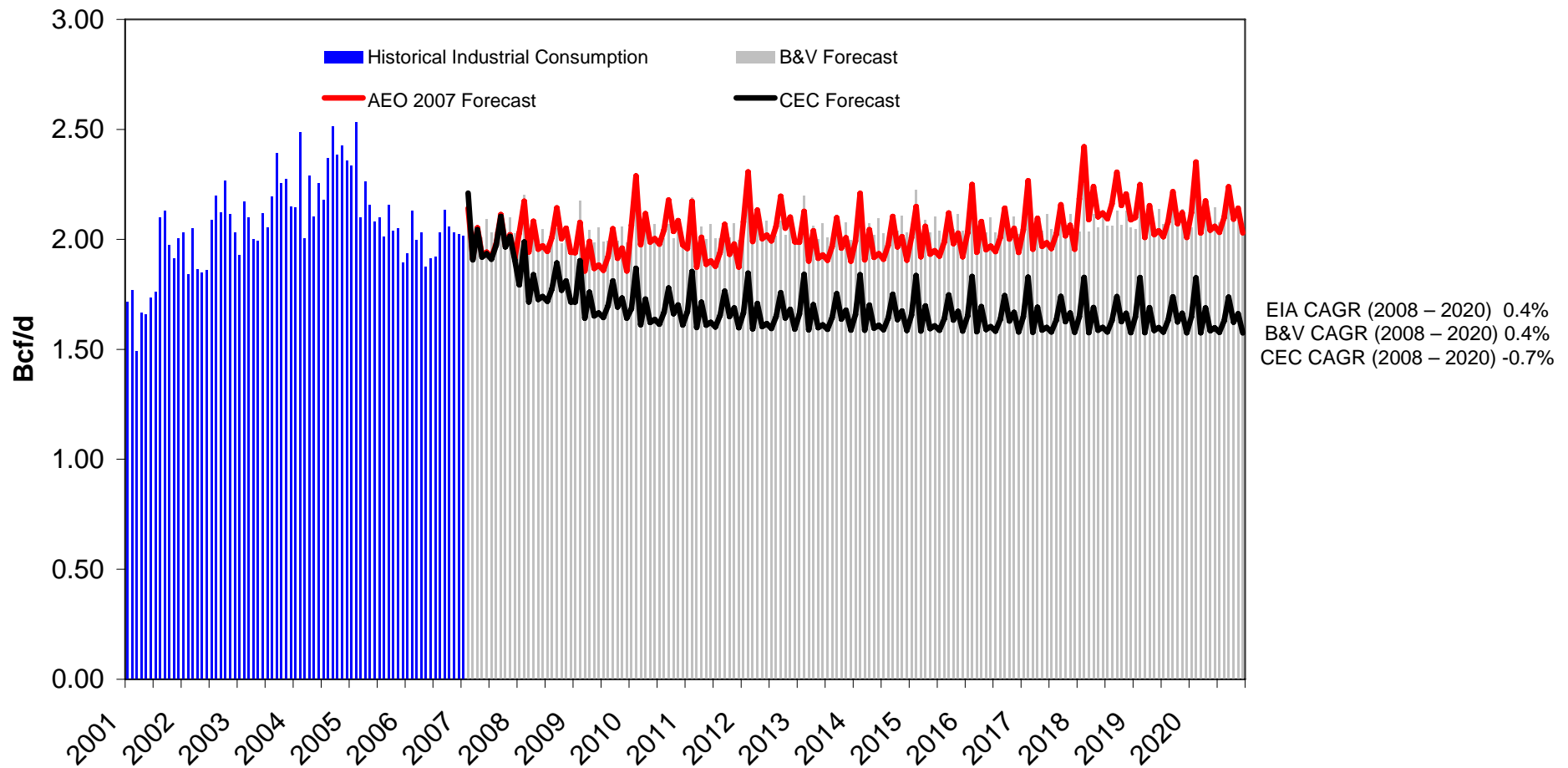
CA Core Demand Forecast



EIA CAGR (2008 – 2020) 1.1%  
B&V CAGR (2008 – 2020) 0.7%  
CEC CAGR (2008-2020) 2%

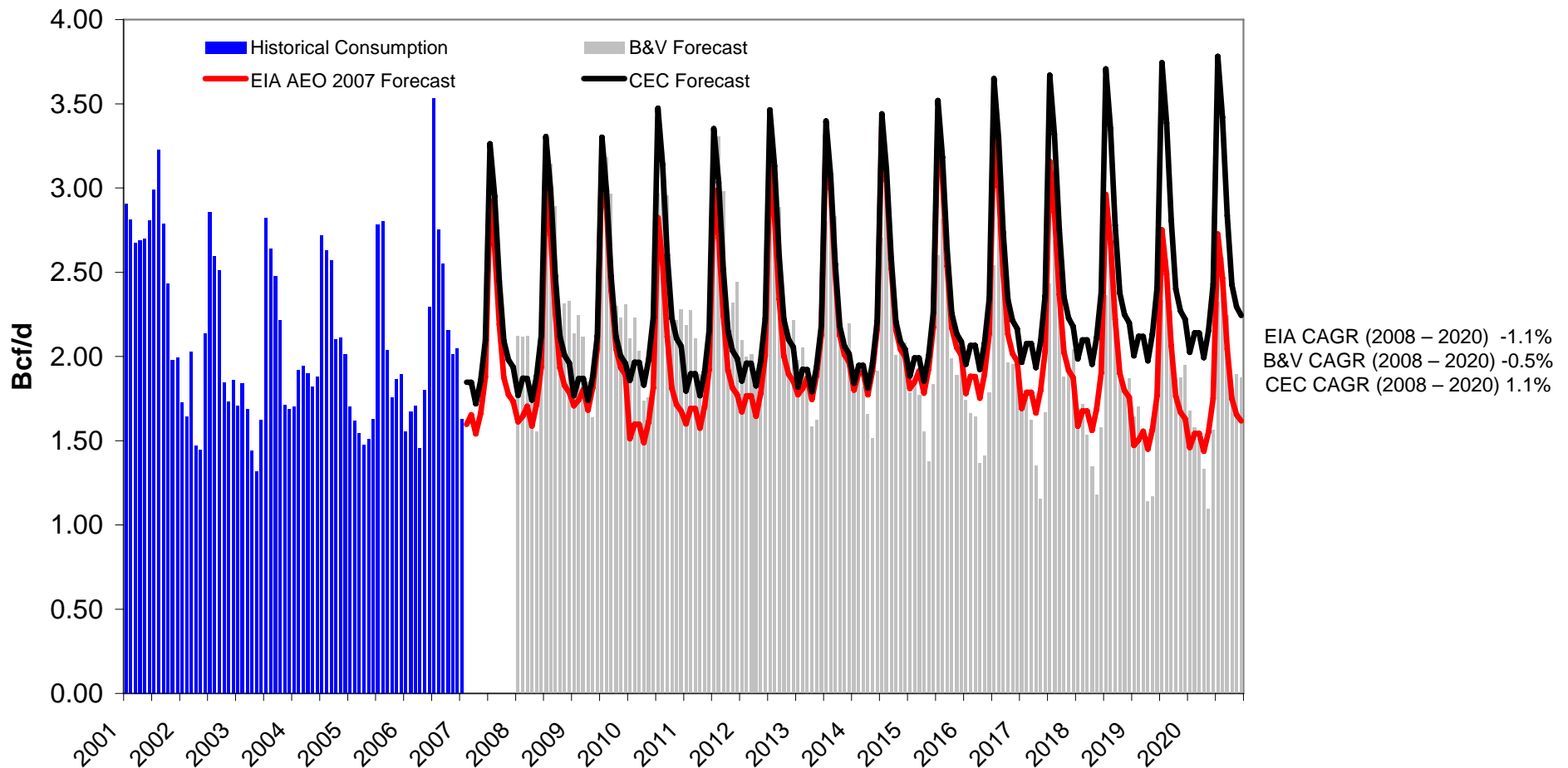
## Industrial demand is expected to grow at 0.4% CAGR or 30 Bcf over the study period

CA Ind Demand Forecast

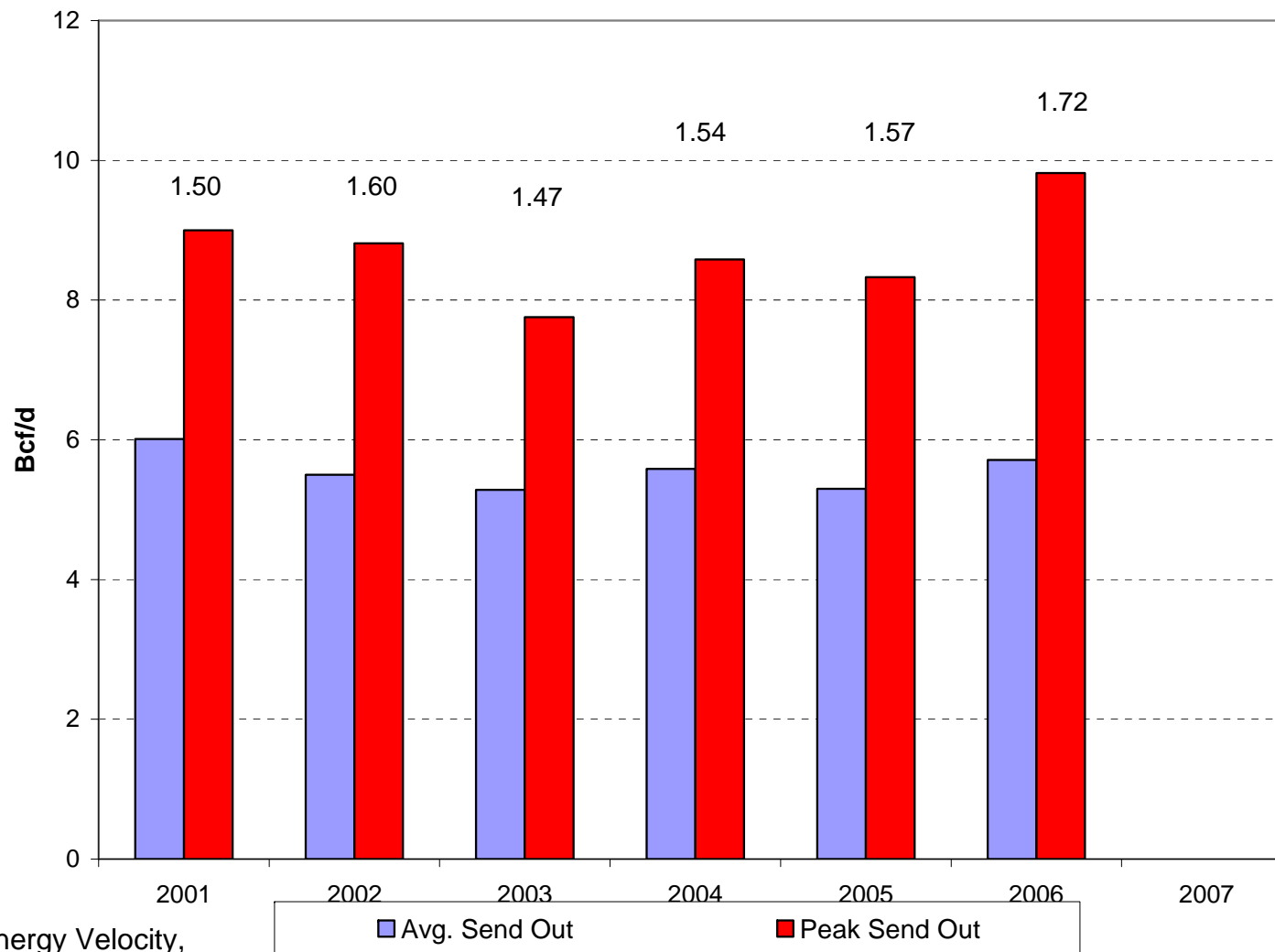


## Electric gas demand is expected to grow at a rate of 1.6% CAGR or 235 Bcf from 2008 to 2020

CA Elec Demand Forecast

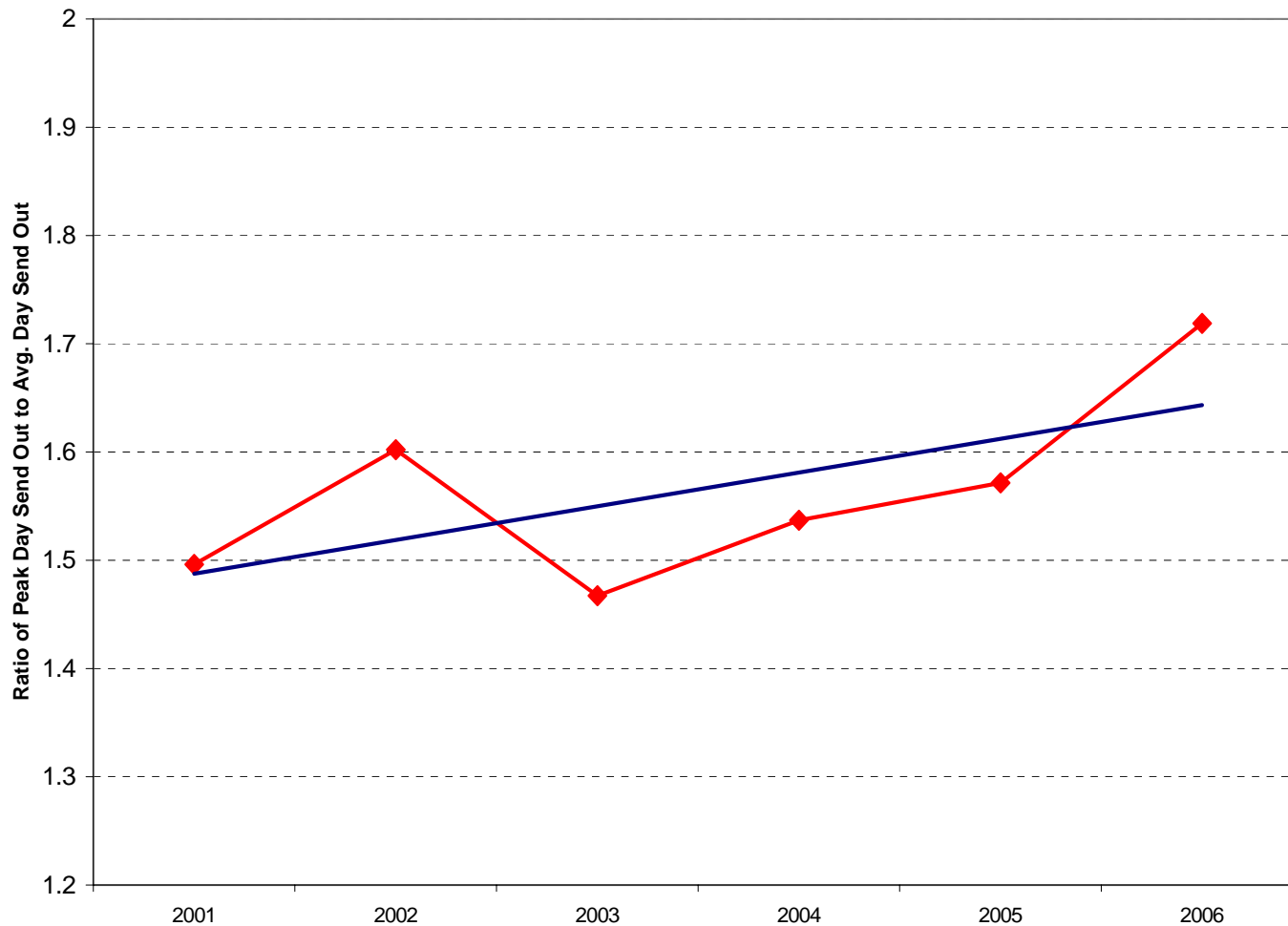


## Peak Day Send Out vs. Average Day Send Out – Total California



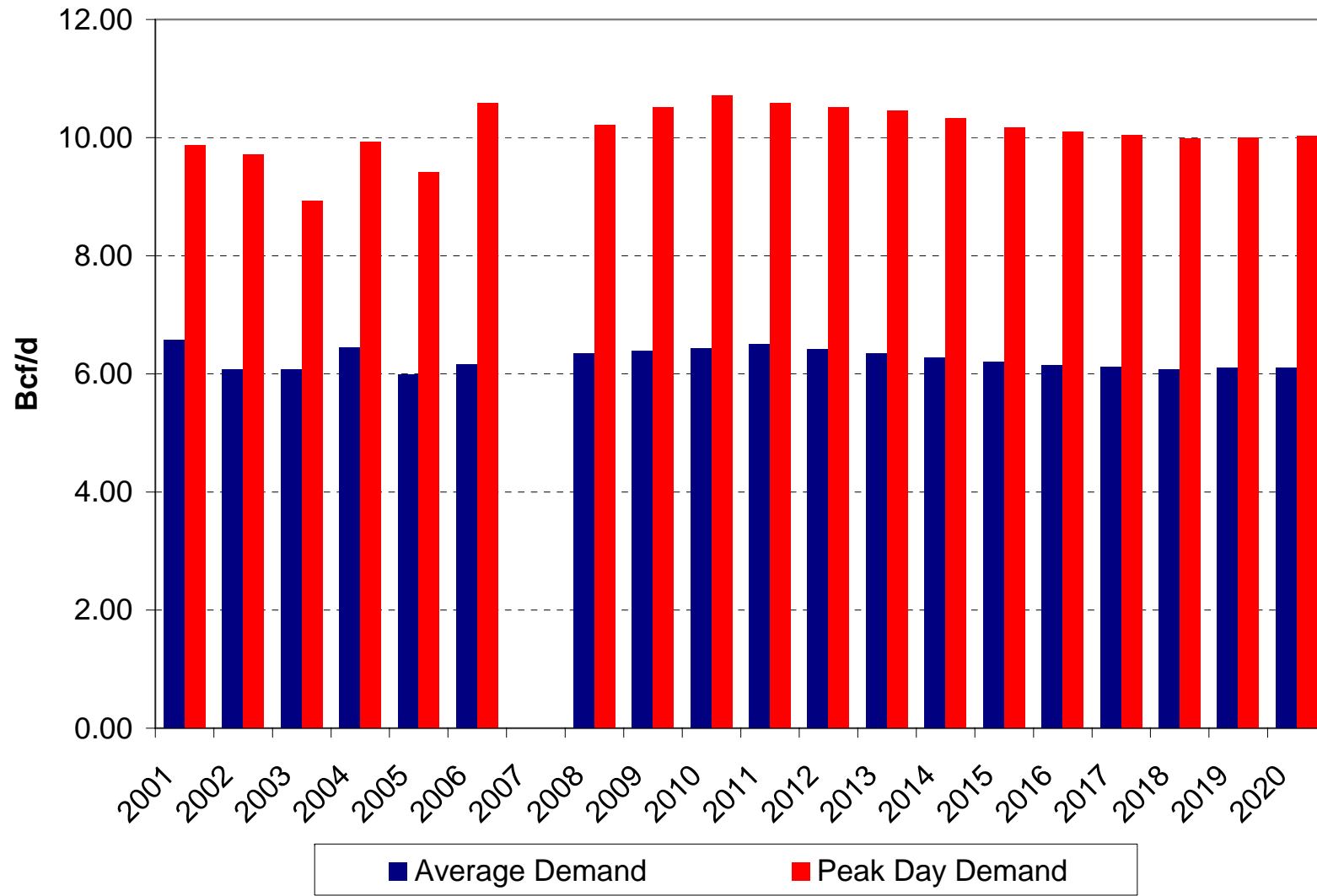
Source: Energy Velocity,  
B&V analysis

## California peak send out appears to be growing faster than average day send out



Source: Energy Velocity, B&V analysis

## Peak Day Demand – History and Forecast

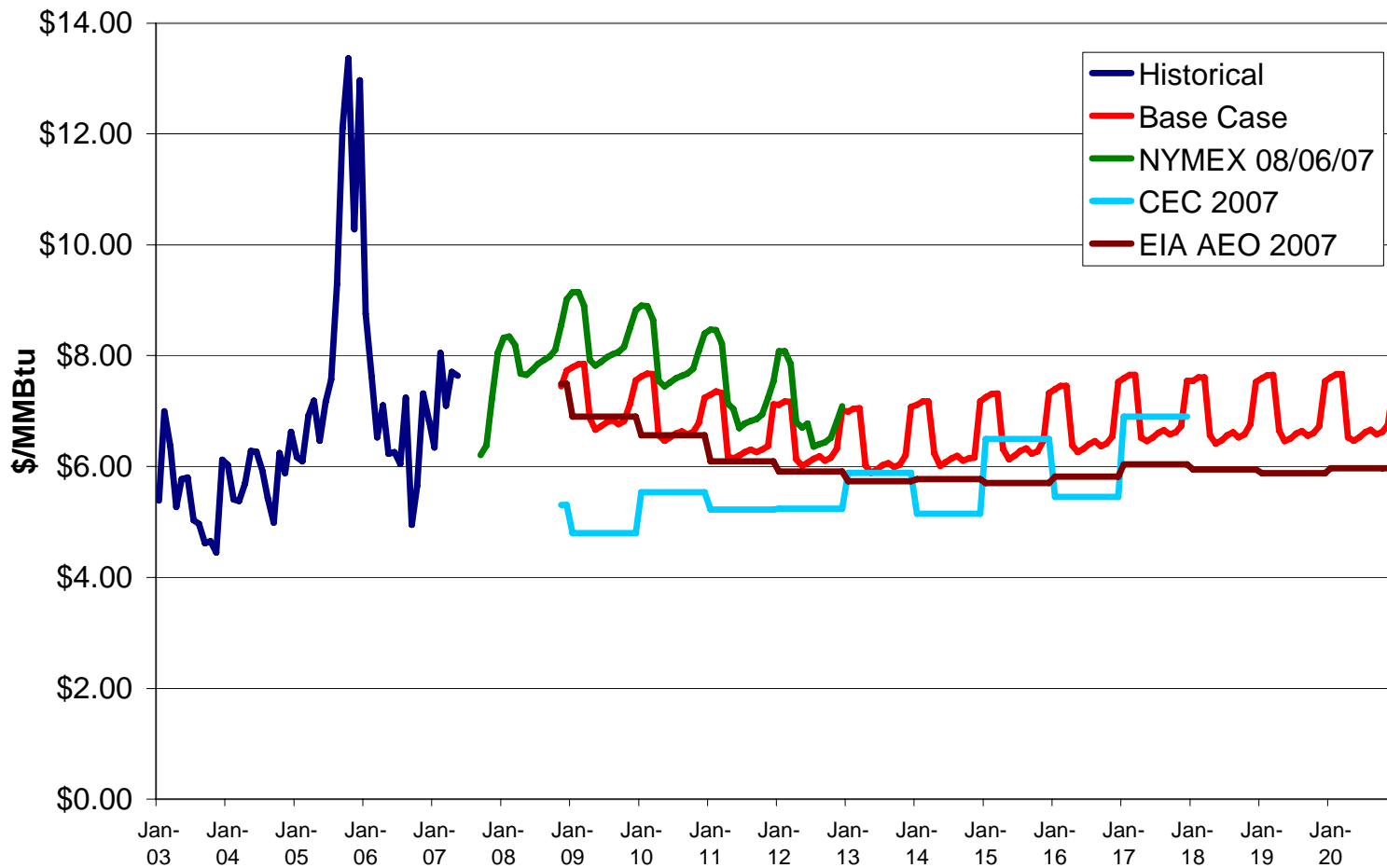


Source: Energy Velocity, B&V analysis

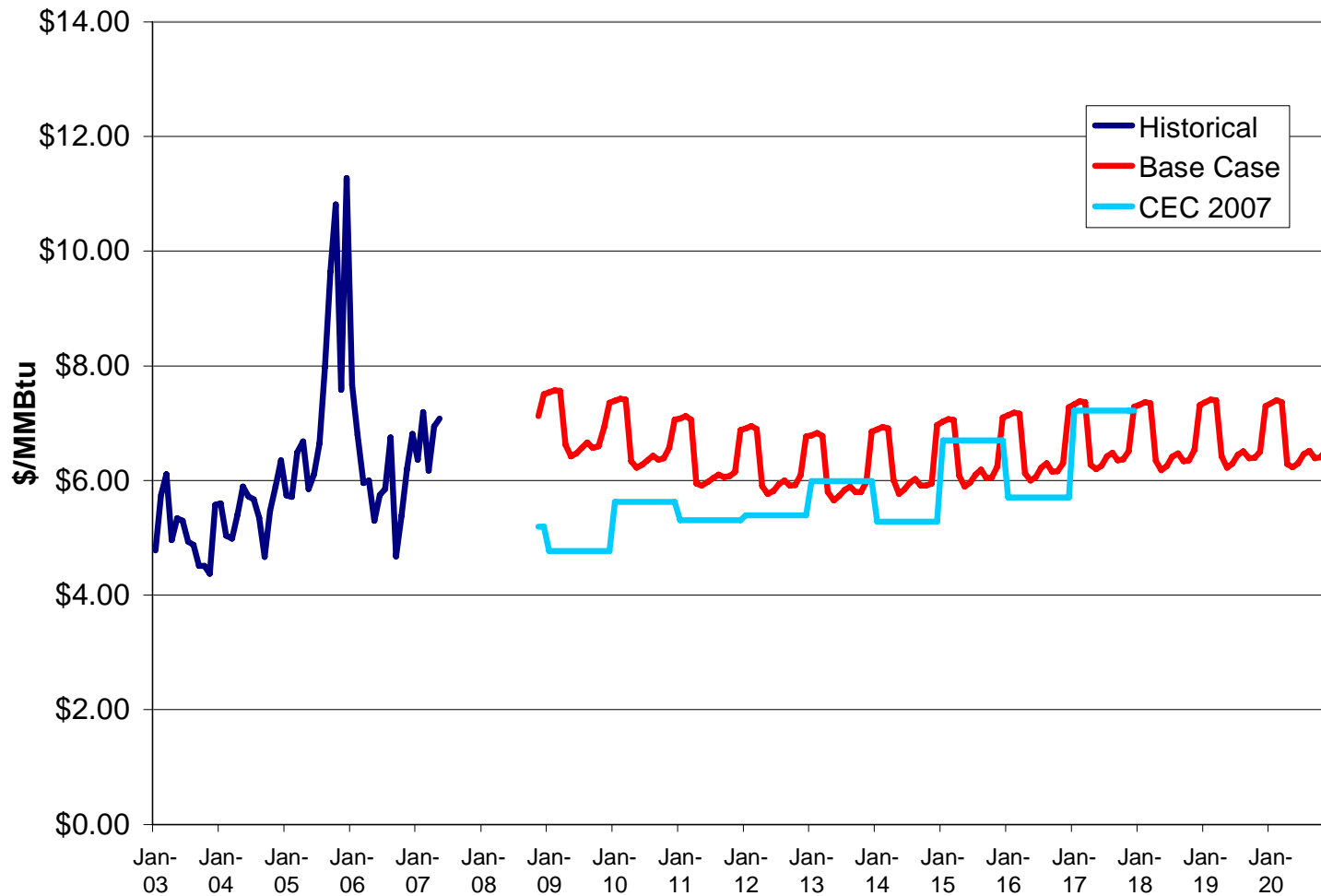
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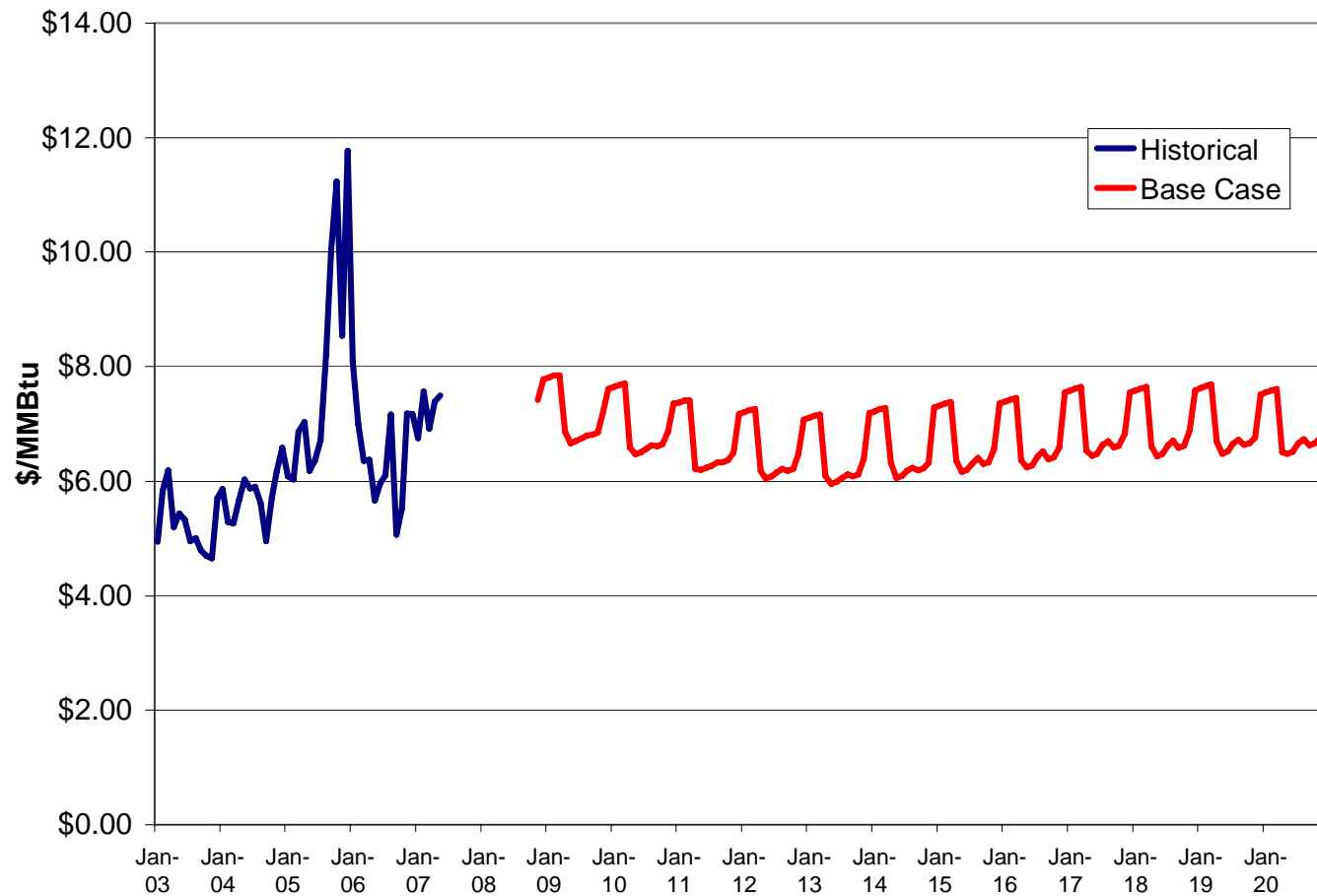
# Henry Hub Price Projections



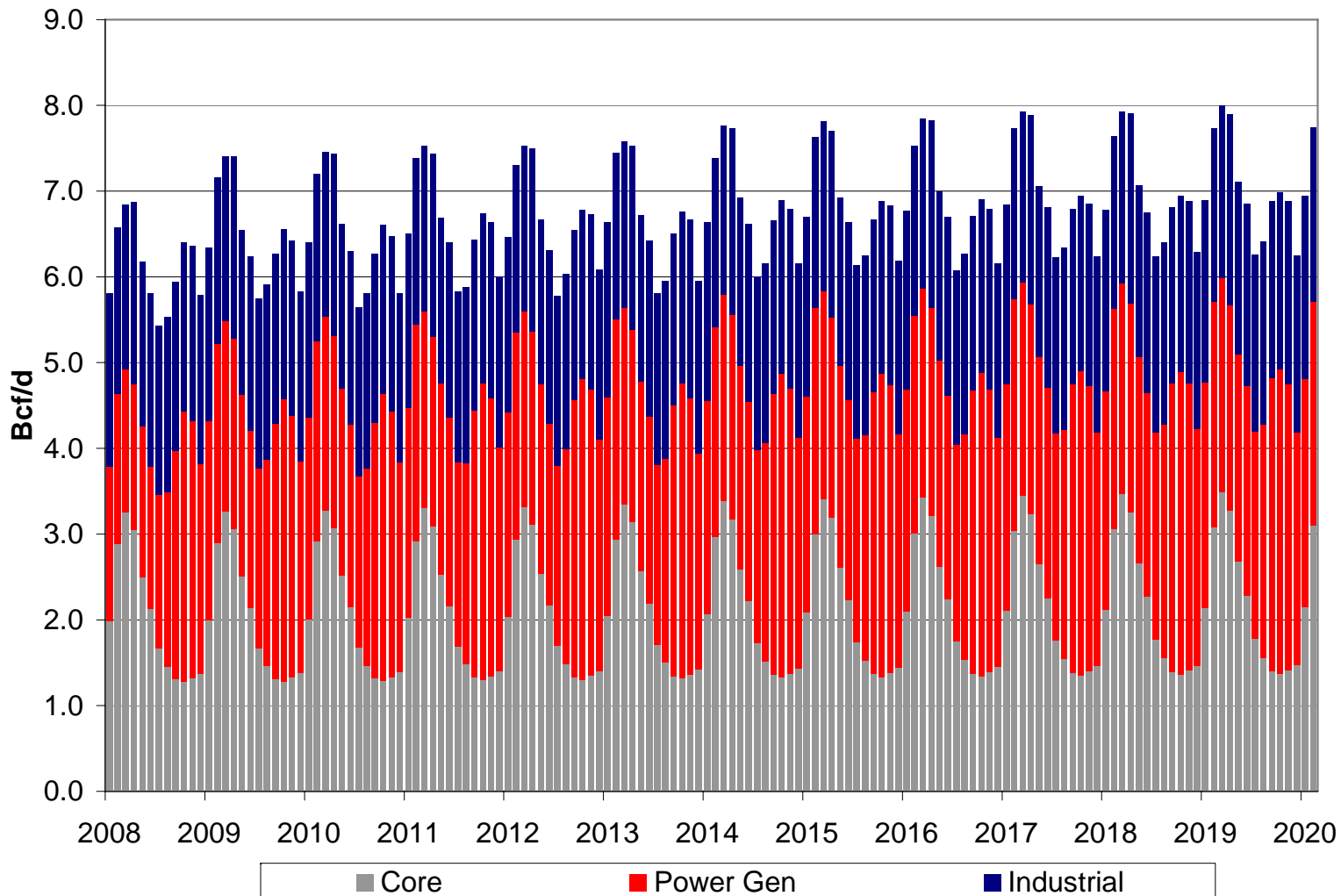
# SoCal Price Projections



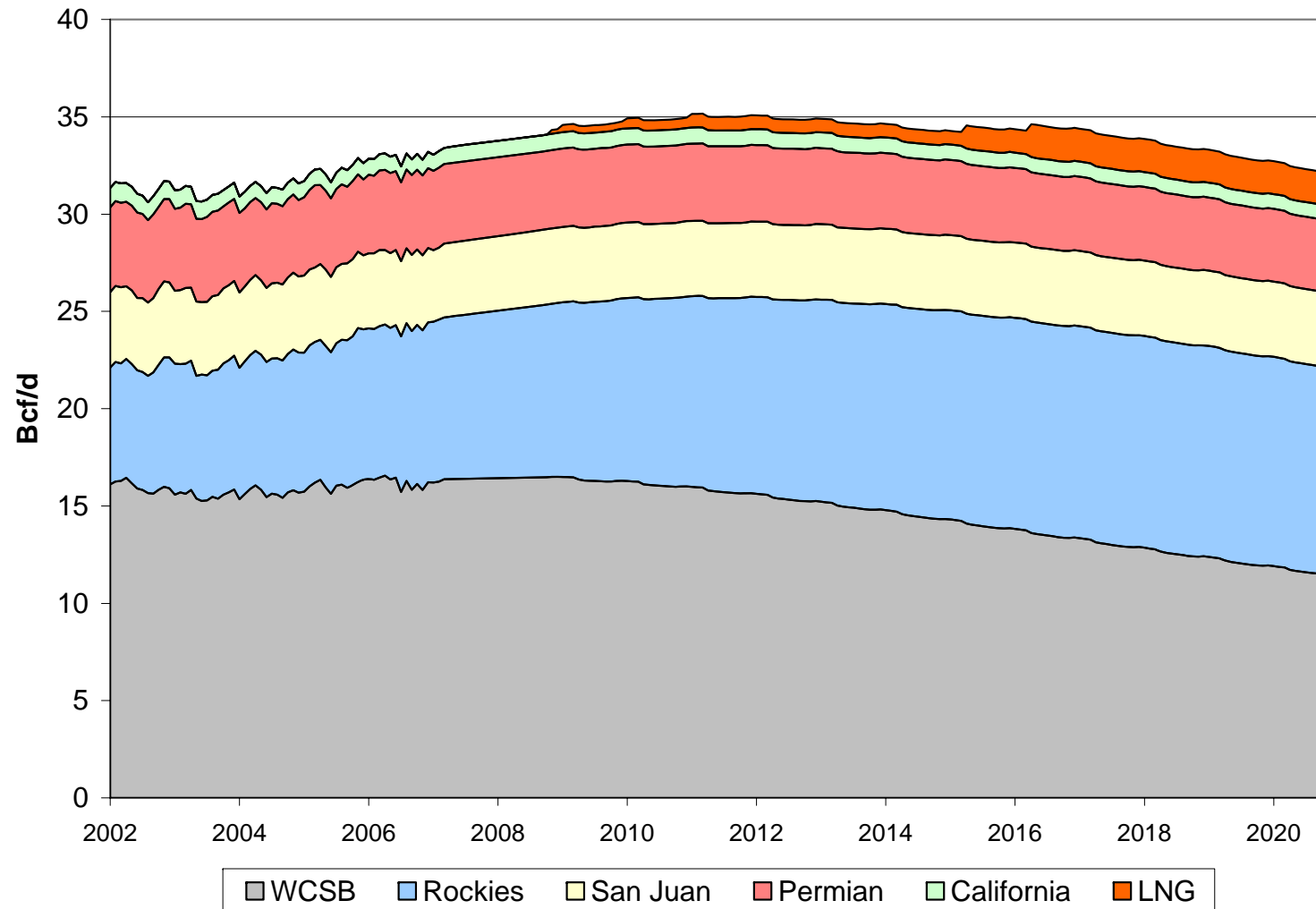
# PG&E Price Projections



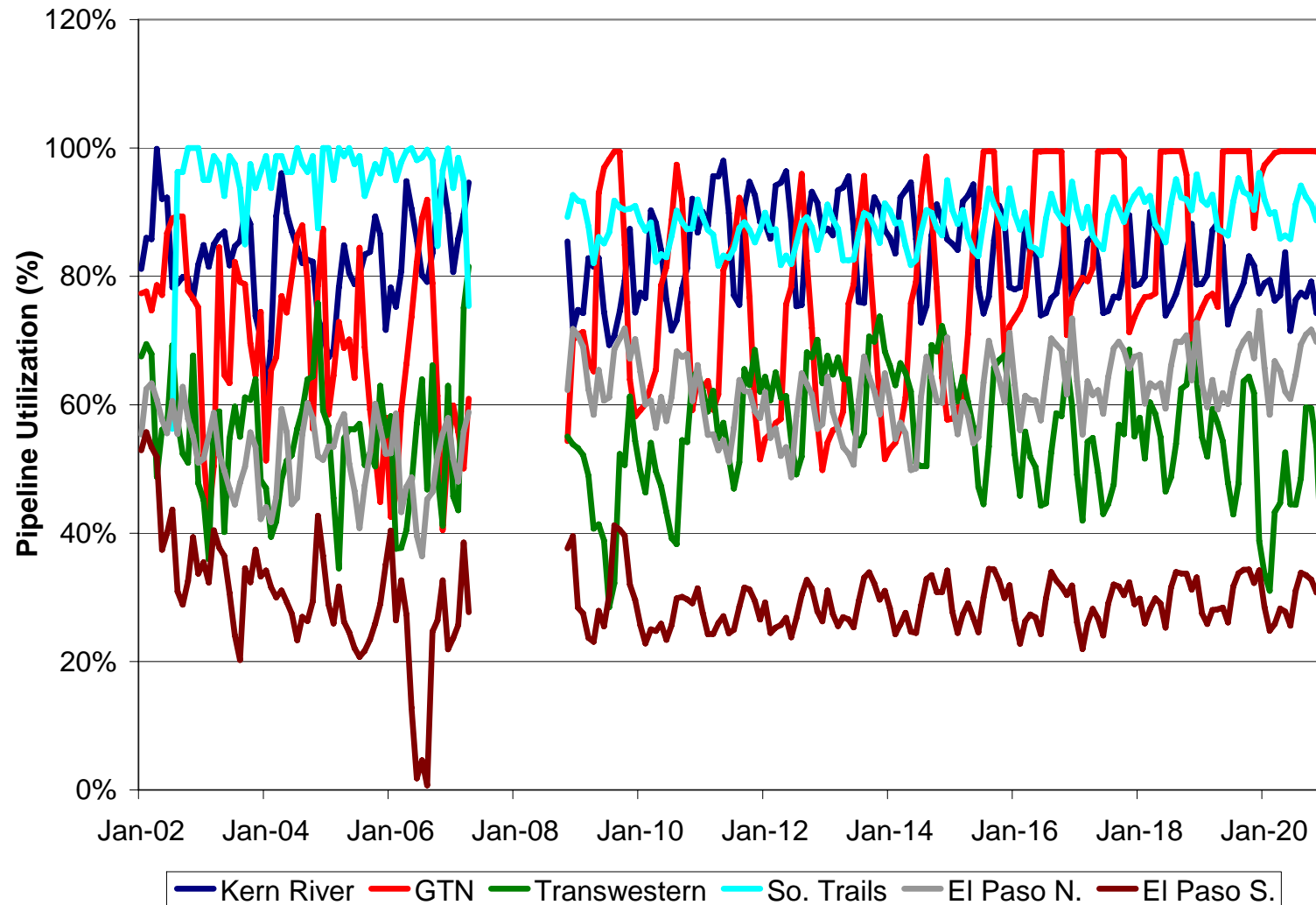
## California consumption is expected to grow with a CAGR of 1.1% over the study period



## LNG and Rockies production contribute to the increase in supply among the sources serving California



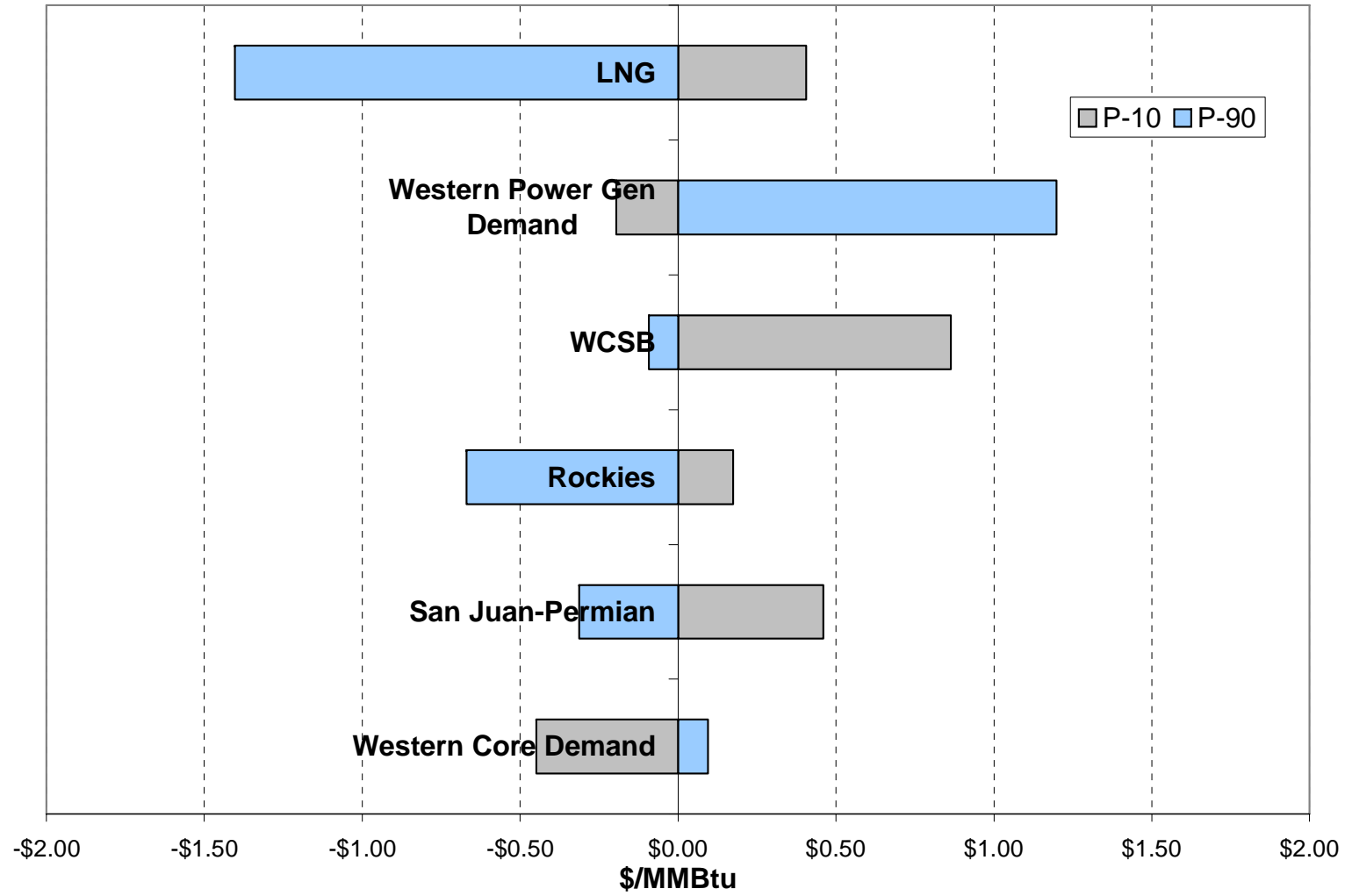
## Pipeline utilization is expected to remain high for pipelines from the WCSB and the Rockies



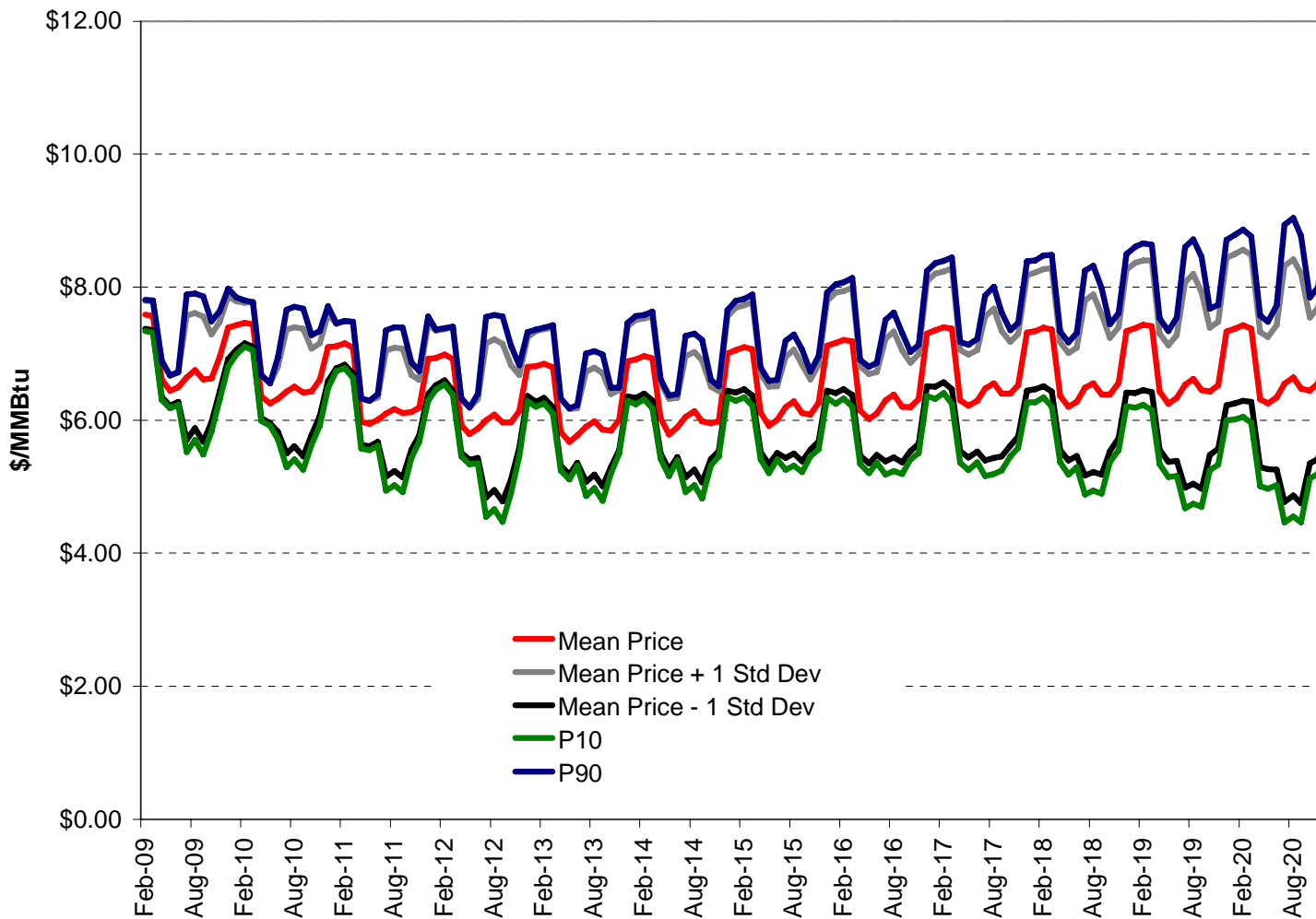
## Sensitivity Analysis to Determine the Impact of Uncertainties

- Fundamental supply/demand drivers impacting natural gas prices in California
  - WCSB Production
  - R & C Demand
  - Gas Demand for Power Generation
  - Rockies Production
  - San Juan & Permian Production
  - LNG Imports

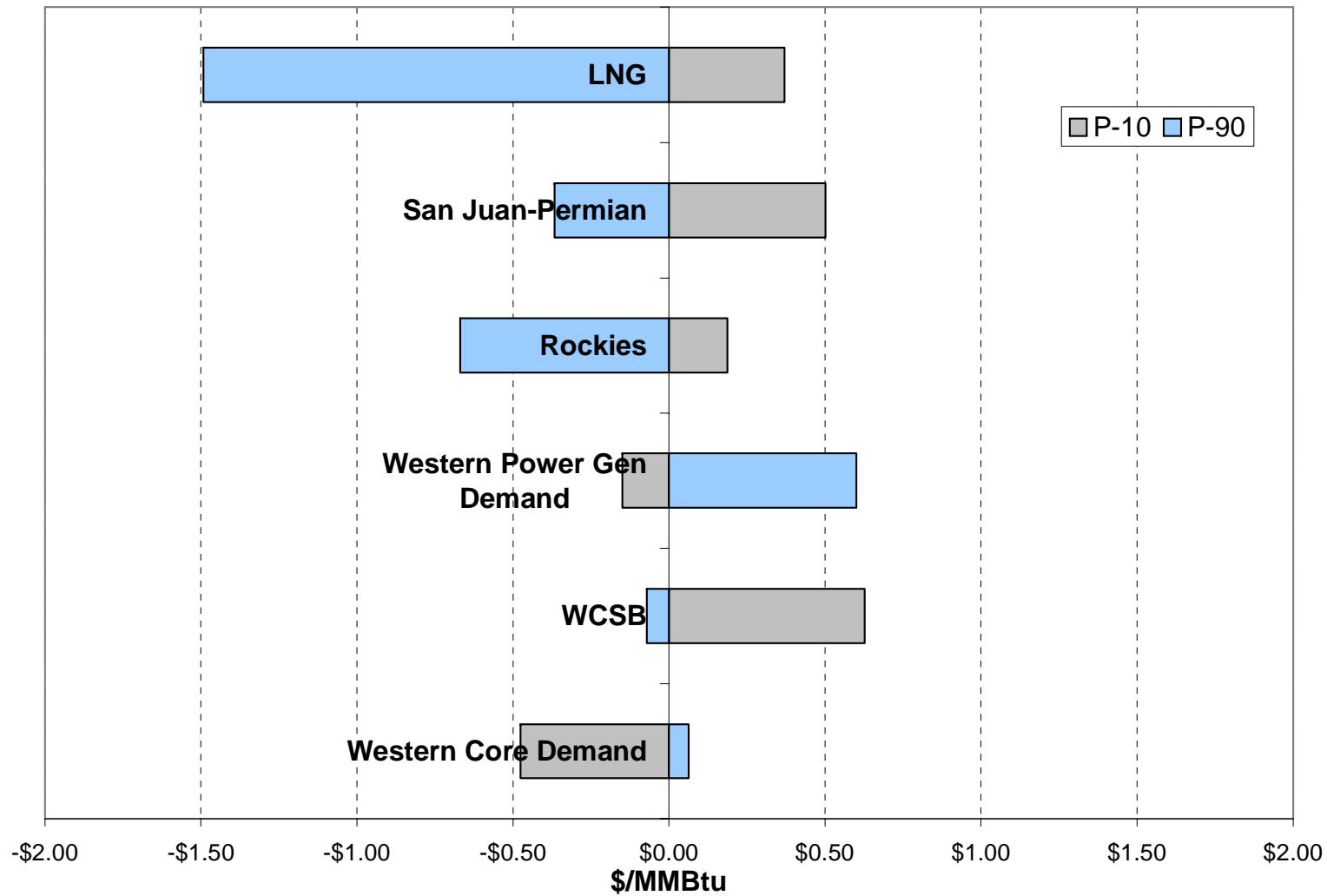
## Impact of Fundamental Drivers on PG&E prices in 2020



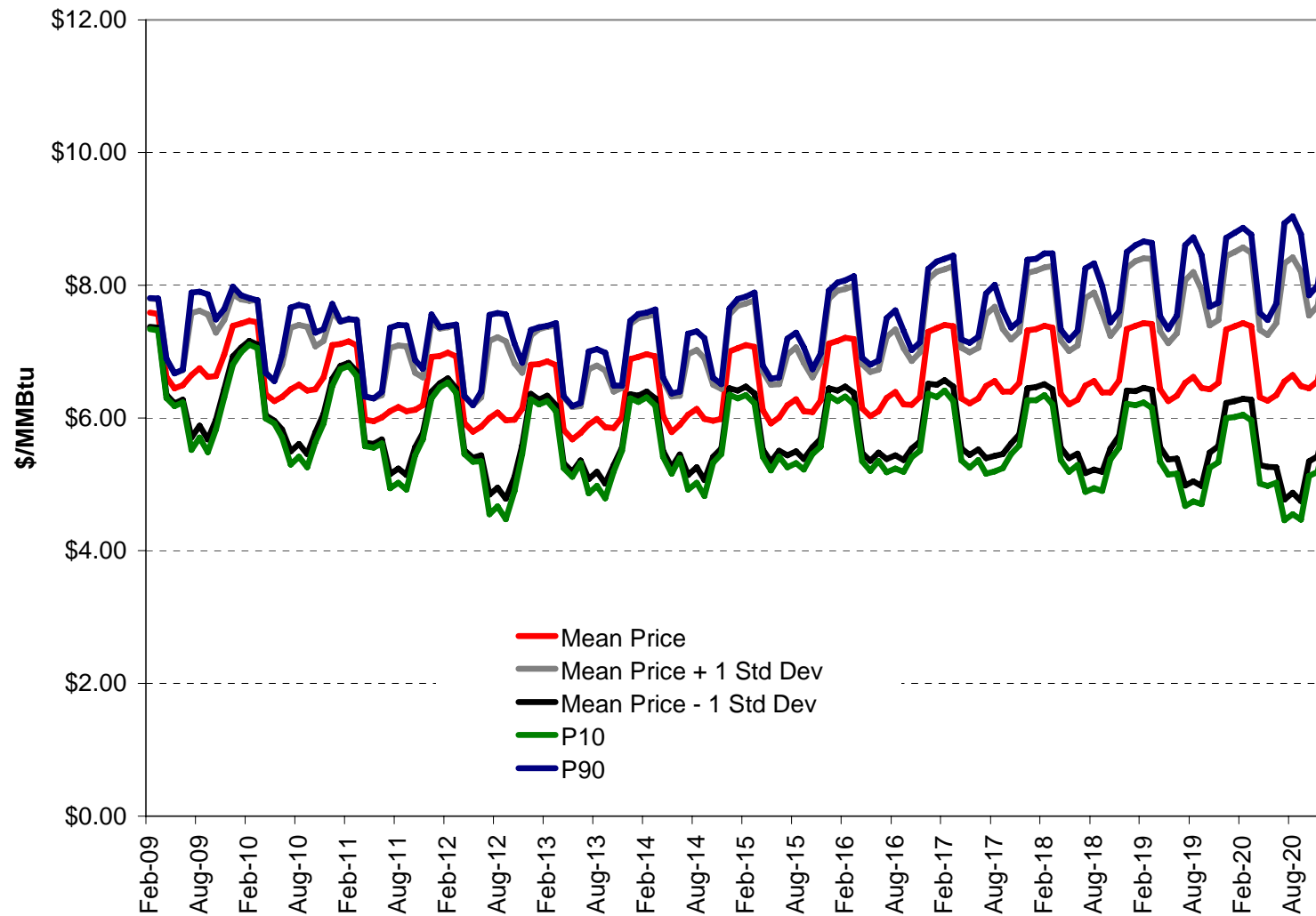
## Range of PG&E Prices



## Impact of Fundamental Drivers on SoCal prices in 2020



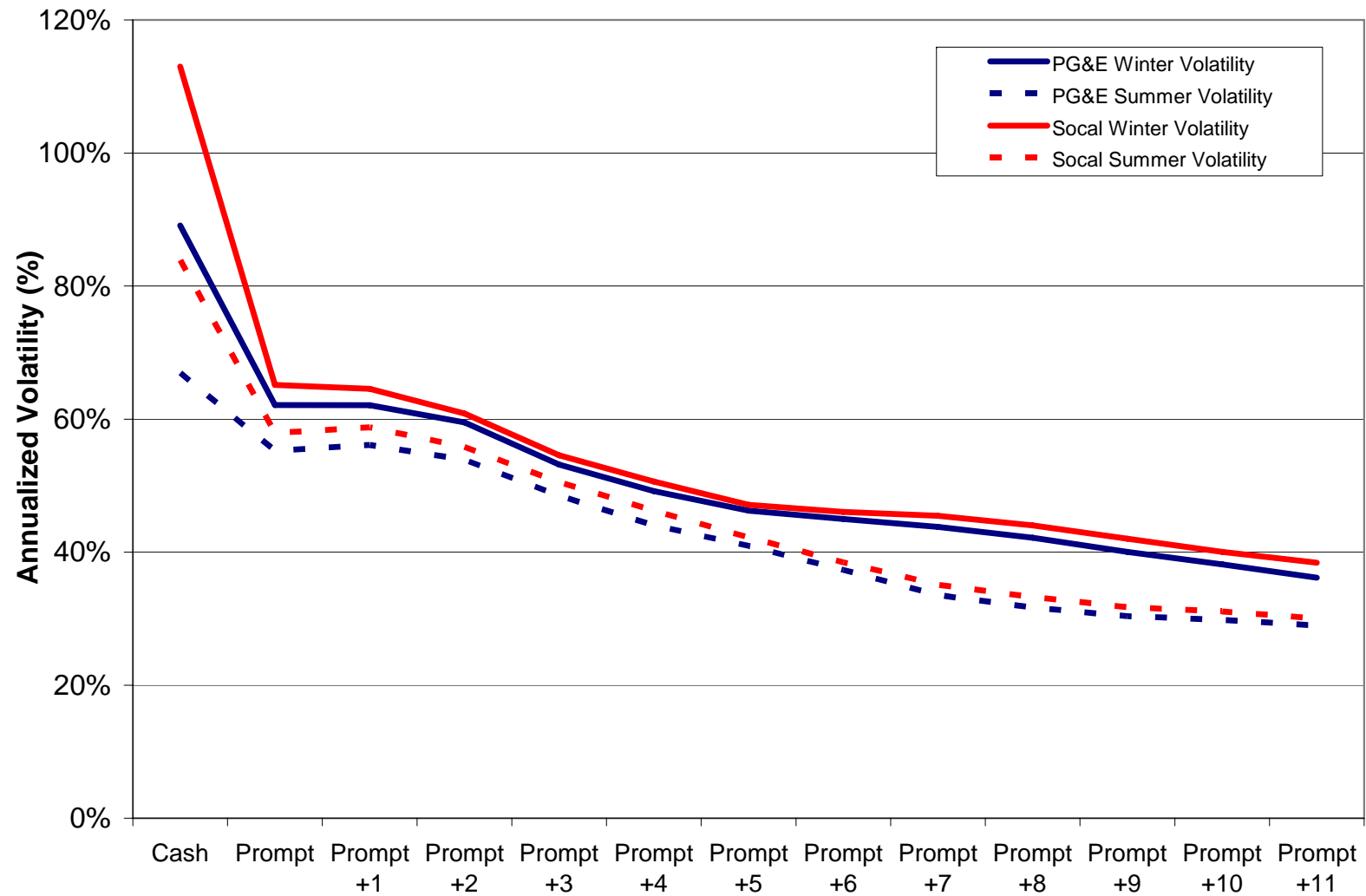
## Range of SoCal Prices



## The uncertainty in equilibrium prices at SoCal & PG&E increases the expected price volatility over time

- Historically, the FOM price volatility estimates using a mean-reversion process at PG&E and SoCal are 88%
- The uncertainty in fundamental price drivers is estimated to increase the volatility by 4-5%
- Increase in FOM (spot price) volatility will also lead to increase volatility in the futures market
- Given that price volatility is a key factor in influencing arbitrage storage value (primary valuation methodology utilized for independent storage facilities), increases in volatility could encourage storage development and trading activities.
- Increased storage infrastructure not only provides arbitrage opportunity but also provides short term deliverability to mitigate supply disruptions or demand spikes

## Annualized Volatilities for PG&E and SoCal



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## Summary Observations

- B&V's modeling of California's natural gas market included fundamental analysis, statistical analysis and real options based valuation of storage
- Demand projections:
  - The average annual demand for natural gas in the State of California is projected to grow from 6.2 Bcf/d in 2008 to 7.1 Bcf/d by 2020 under baseline projections
  - Peak day demand is expected to grow faster than average demand in both northern and southern California
- Prices are expected to increase during the study period:
  - SoCal price is expected to increase from \$5.50/MMBtu in 2008 to \$7.50/MMBtu by 2020
  - PG&E City-gate price is also expected to increase from \$5.80/MMBtu in 2008 to \$7.80/MMBtu in 2020

## Summary Observations

- Natural gas supply to the state is projected to grow from approximately 5.7 Bcf/day to 6.4 Bcf/day by 2020
- Under the normal weather average month demand assumption incorporated in the current base case, existing storage assets in California are well utilized
- The price in Southern California is expected to range between \$6.20/MMBtu and \$7.07/MMBtu in 2020 due to the uncertainty in actual supply/demand factors
- Northern California prices is expected to range between \$6.80/MMBtu and \$8.20/MMBtu in 2020 due to the uncertainty in actual supply/demand factors
- Volatility is expected to increase by 5% over the analysis period; market conditions will remain supportive for future development of independent storage facilities with market based rates